

Student Name: _____



BIOLOGY 2017

Unit 3

Key Topic Test 4 – Structure and regulation of biochemical pathways

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out

Materials supplied

- Question book of 11 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Many reactions that occur in cells occur at rates that would be too slow to sustain life. Enzymes allow these reactions to occur at a speed that can sustain life. Without the presence of enzymes, the reactions necessary to sustain life would require

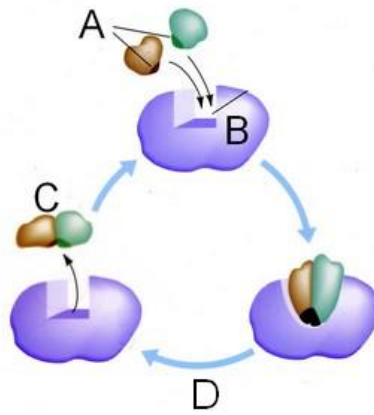
- A. larger cells.
- B. higher temperatures.
- C. larger proteins.
- D. smaller atoms.

Question 2

The part of the enzyme where the substrate binds is called the

- A. active site.
- B. catalyst.
- C. inhibitor.
- D. large subunit.

Use the following diagram to answer Questions 3 – 5.



Question 3

Which letter represents the enzyme?

- A. A.
- B. B.
- C. C.
- D. D.

Question 4

Which letter represents the substrate?

- A. A.
- B. B.
- C. C.
- D. D.

Question 5

Which letter represents the product of the reaction?

- A. A.
- B. B.
- C. C.
- D. D.

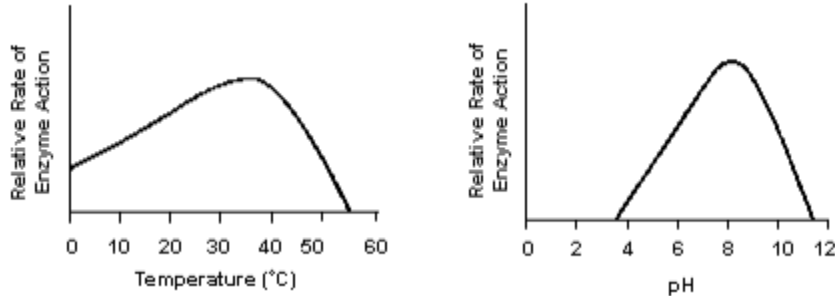
Question 6

Enzymes are composed of

- A. sugars.
- B. DNA.
- C. fatty acids.
- D. proteins.

Question 7

The following diagram shows the rate of enzyme action for a particular enzyme at various temperature and pH.



Which of the following statement best describes the enzyme represented in the graphs?

- A. This enzyme works best at a temperature of 35°C and a pH of 8.
- B. This enzyme works best at a temperature of 50°C and a pH of 12.
- C. Temperature and pH have no effect on the action of this enzyme.
- D. This enzyme works best at a temperature above 50°C and a pH above 12.

Question 8

ATP is the universal source of free energy for all living organisms. It is composed of adenine and ribose with how many phosphate groups attached?

- A. 1.
- B. 2.
- C. 3.
- D. 4.

Question 9

The reaction $ADP + P_i \rightarrow ATP$

- A. requires energy.
- B. is irreversible.
- C. provides the energy required to drive cellular processes.
- D. only occurs in prokaryotes.

Question 10

NADH is a coenzyme that carries electrons to the different stages of

- A. The ATP/ADP cycle.
- B. cellular respiration.
- C. photosynthesis.
- D. phosphorylation.

SECTION B - Short-answer questions

Instructions for Section B
Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1

Knowing a protein's structure is important in explaining how it acts. It is the tertiary structure that determines the function of a protein. The folding of an enzyme into its tertiary structure creates a specific shape on its surface into which a substrate, the substance being acted on, can fit. This part of the enzyme is called the active site.

- a. Explain the difference between the lock-and-key model and the induced-fit model for how a substrate binds to the active site of an enzyme.

2 marks

- b. Draw a labelled diagram of what an enzyme-substrate complex might look like.

2 marks

- c. Explain how a change in an enzyme's shape can affect its function.

2 marks

- d. List four properties or characteristics of enzymes (apart from the type of molecules that make them up).

4 marks
Total 10 marks

Question 2

Different enzymes have different temperatures at which they operate optimally. Human enzymes tend to operate most effectively at 37°C, whereas *Thermophilus aquaticus*, a bacterium that lives in hot springs and hydrothermal vents, enzymes have an optimum temperature of 75 - 80°C.

Temperature	Enzyme A	Enzyme B	Enzyme C	Enzyme D
0°C	2	0	0	0
20°C	7	2	0	0
40°C	15	7	2	0
60°C	7	15	7	2
80°C	2	7	15	7
100°C	0	2	7	15
120°C	0	0	2	7
140°C	0	0	0	2

Enzymes were taken from four different species and their activity was tested over a range of temperatures. The results are recorded above.

- a. What is the optimal temperature for Enzyme A?

1 mark

- b. Describe what is happening to the structure of Enzyme A at 100°C.

2 marks

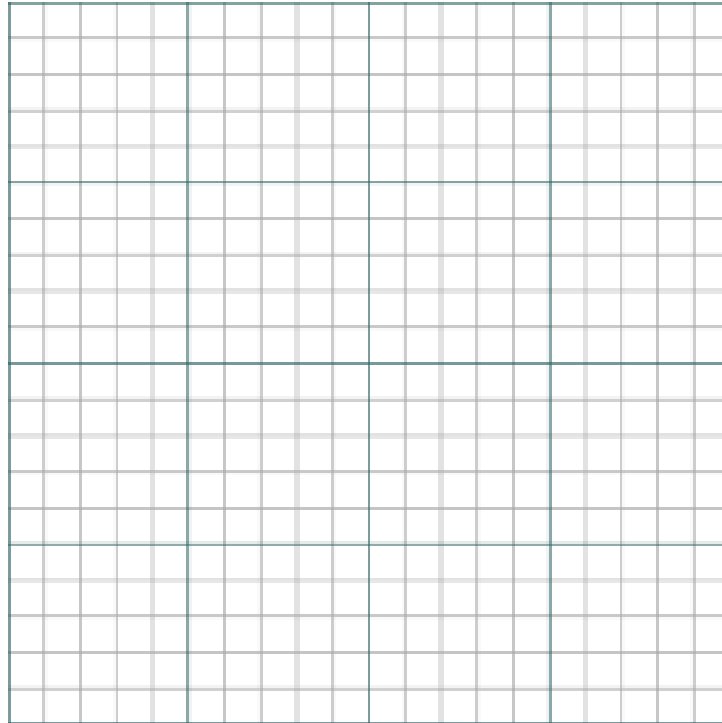
- c. Enzymes can sometimes be inactivated by substances that bind to them. This is known as inhibition and can occur as part of normal cellular processes, or it can be caused by toxins. Use labelled diagrams to illustrate competitive and non-competitive inhibition of an enzyme.

Competitive inhibition

Non-competitive inhibition

4 marks

d. Present the information found in the above table graphically for enzyme D.



3 marks

e. Other than temperature and inhibition. Name two other factors that can affect enzyme action.

2 marks

Total 12 marks

Question 3

The cycling of coenzymes ATP, NADH and NADPH are essential to move energy, protons and electrons between reactions in the cell.

- a. Describe the role that each of these coenzymes play. Include their loaded and unloaded forms in your answer.

6 marks

- b. Draw a labelled diagram that illustrates the ATP/ADP cycle.

2 marks

2017 BIOLOGY KEY TOPIC TEST

c. Some people are born with less ability to take up oxygen and transfer energy than others. Research suggests that these people have reduced levels of oxidative enzymes and proteins used to generate energy in skeletal muscle.

i. Which organelle would contain the reduced levels of oxidative enzymes?

ii. Which coenzyme might be found in reduced levels in someone not able to become a world class athlete?

iii. Ultimately what molecule does this mean is not being produced by the skeletal muscle in as high levels as someone who is able to take up high amounts of oxygen and transfer energy?

1 + 1 + 1 = 3 marks

d. Cyanide is takes the place of oxygen molecules that bind to the active site of an enzyme that is critical for energy production. Justify your response.

2 marks

Total 13 marks

END OF KEY TOPIC TEST